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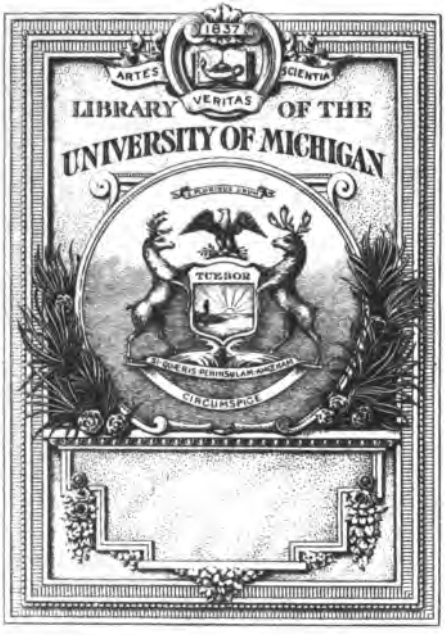
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TRAINING FOR THE ELECTRIC RAILWAY BUSINESS

WRITTEN UNDER THE SUPERVISION OF

T. E. MITTEN

CHAIRMAN, EXECUTIVE COMMITTEE PHILADELPHIA RAPID TRANSIT COMPANY

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FOREWORD

THE preparation of this book has been undertaken at the urgent request of the publishers. The purpose of the book is to explain, non-technically, the business side of electric railroading and, by defining the electric railway organization and its varied functions, to give an insight into the requirements, the opportunities and the training involved in the several departments of this exacting business.

Upwards of twelve billion passengers are carried annually upon the electric lines of this country. That is to say, on the average every man, woman and child in the United States rides upon an electric car more than one hundred and twenty times a year.

Notwithstanding this close personal contact with the service, the average citizen knows almost nothing of the complex transportation and engineering problems involved; of the training through which the

executive officers and department heads must pass to gain proficiency; nor of the recruiting, management and training of the great army of motormen and conductors, artisans, clerks and laborers who work behind the scenes, in office, on the cars, in shop, in car house, in power plant, on the wires and on the track.

To the human mind, the new, the unusual, the startling, become almost immediately the commonplace, and are thereafter taken for granted and as a matter of course.

So it is with the street car ride. The daily rider takes it almost in the same matter of fact way that he breathes. He walks to the corner and if the car comes along in a reasonable time, on he gets and goes to his destination without a thought about the intricate organization of men, of materials, and of methods, that has made that particular ride possible just at the time he wanted to take it.

Of modern public utilities, *e.g.*, the telephone, the telegraph, the electric light, the

gas supply, the steam railroad and the electric railway, all of which enter so intimately into the daily lives of the people, it safely may be said, none has exerted a more beneficent influence upon the growth and prosperity of our American communities, and none has become more nearly indispensable to the individual citizen, than has the electric railway.

There are in the United States about one thousand electric railway companies, operating in the aggregate approximately forty-eight thousand miles of track and one hundred thousand cars. The total capitalization of these properties is something over five billion dollars and the gross annual receipts are over five hundred million dollars. There are employed about three hundred thousand persons whose annual salaries and wages total more than three hundred million dollars. So much for the magnitude of this business.

Incidentally, it is interesting to note, no name has as yet been coined that is sufficiently comprehensive to include all the various gra-

dations of the electric railway, *i.e.:* City surface lines serving strictly urban communities; suburban lines built for the most part as extensions of city systems into suburban sections; subway and elevated systems built to relieve or because of surface congestion in the larger cities; interurban roads operating at high speed and designed to connect urban centers and intervening rural communities; and electrified steam roads representing the most recent application of electricity as a transportation agency.

Abroad, the word "tram" or "tramway," and in the United States, the term "street railway" have served in a measure to designate the horse, cable and electric railway as distinguished from the steam railroad, but these terms have long since been outgrown. The term "trolley," by popular usage, has come to mean almost any car propelled by electricity, but technically the word does not apply to many installations which do not use the trolley at all but take current from a third rail, as on most elevated and subway

systems, or from an underground conduit, as on the systems in New York City and Washington, D. C. Nor is it appropriately applied to electrified steam roads or to roads operated by storage battery cars or other self-contained methods of propulsion.

Now that horse and cable cars have practically disappeared, the term "electric railway," while neither wholly apt nor euphonious, is probably the most comprehensive.

While primarily this book is intended to bring something of value and perhaps of inspiration to the young man looking forward, it is hoped it may not be wholly without interest to the older student of affairs who occasionally likes to delve into the business problems of the other fellow.

December, 1918. C. B. F., Jr.

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TRAINING FOR THE ELECTRIC RAILWAY BUSINESS

ORGANIZATION

A COMPLEX BUSINESS

The trend in most present day industries and in the professions is towards specialization. We find the modern factory increasing the quantity of its output, but narrowing its activities to one or more specialties or perhaps to only part of one specialty. Likewise the general practitioner in law or medicine, so common fifty years ago, has been largely superseded by the specialist.

In direct contrast to this trend towards specialization, the training of the electric railway executive must be in the direction of greater and greater generalization. Instead of being a specialist in one line he must be an expert in several lines; for the business of supplying electric railway transportation

is really a correlation of many sciences, professions and trades.

To one who has not analyzed the subject particularly, it may be a surprise to discover how many ramifications of human knowledge are directly involved in this industry.

For example, no electric railway could be built or continued in operation without the application of the three main branches of engineering,—viz., electrical, mechanical and civil.

Electrical engineering is required to produce the power, which must be generated at a central power plant, distributed over the cables and trolley wires, and utilized in the motors to propel the cars, in the air brake mechanism to stop them, and in the heaters and lamps to heat and light them.

Mechanical engineering is necessary in designing, constructing and repairing the cars and car parts, trucks, motors, brakes, wheels, gears, pinions and the many other mechanical appliances and contrivances that go to make up the modern trolley car. Shop facili-

ties are needed for inspecting, repairing and painting the rolling stock; and these involve many additional problems of mechanical science, as for example, shop equipment and shop management.

Civil engineering enters into the construction and repair of the track, paving, bridges, buildings and roadway structures of many sorts, including subways and elevated structures.

In varying degree there must be applied other specialized branches of engineering knowledge. Of these, architecture, chemistry, telephony, concrete engineering and fire protection are important examples. If the power plant is operated by steam, steam engineering will be a requisite; if by water power, hydraulics will be involved.

Differing from the engineering problems, but of equal importance, the actual transportation of the passenger and freight traffic, including the scientific making of time-tables and schedules to meet the needs of the public, is a science in itself.

More strictly in the line of business administration are problems of finance, accounting, claims adjusting, purchasing, law, real estate, publicity, insurance in most of its forms, and business efficiency, the latter being as important in this industry as in any other.

Then there are many aspects of railway management difficult of classification, but of vital importance. Many of these have a relation to the sciences of sociology and political economy; having to do with the welfare, wages and working conditions of employes; transportation in its effect upon the communities; rate-making; taxation; municipal, state and national legislation and regulation; and "safety first" or accident prevention work.

Very frequently other utilities are operated by or in conjunction with the railway, and administrative supervision must be extended into still other fields; as when the company operates an electric light or power supply, a gas plant, water works, steam heating, ferry boats, inclined railways, amuse-

ment parks, toll roads, or other utility services.

To the young man at the threshold of his life work the electric railway industry therefore presents a career both of opportunities and of difficulties: Of opportunities because in an industry so diversified there are offered openings covering a wide variety of training and aptitude; of difficulties because the man who hopes to pass beyond the limits of any one department and reach a place where he may manage several departments must acquire knowledge and experience in all of them.

Lest this presentation of the complex duties involved in electric railway management give rise to any sense of discouragement on the part of the student or neophyte, because of the seemingly gigantic task of mastering so many branches of practical knowledge, a word of explanation is proper. While there is no exaggeration as to the number and magnitude of the functions that must be performed and supervised, familiar-

ity with these intricate problems is not required all at once. The necessary knowledge and experience come one step at a time, by observation, by instruction, by practice and by the spur of routine contact. To the wide-awake man, no matter how lowly the particular position he may be filling, each day opens up a new field of inquiry concerning the work of his own or some other department, and thus by a process of assimilation he gradually acquires an understanding of principles, methods, processes and materials. As this progress continues, his horizon, degree by degree, widens to take in more and more of the range of the company's activities. Thus in the course of persistent effort these things become part of his own working knowledge and that which at the outset seemed an unachievable undertaking is found to be a natural and attainable development.

CORRELATING THE FUNCTIONS

The details of corporate and departmental organization of electric railway companies,

and the titles applied to the executive and subordinate positions, differ through a wide range as between individual companies. This is naturally so, as these matters are dependent upon many variable factors.

The details of corporate organization are in large measure regulated by the laws of the individual states and by the form of financial control or ownership of the properties.

The alignment of departments and the assignment of titles are dependent upon the characteristics of the service supplied, and are influenced by the volume of business done, the miles of track operated, the extent and distinguishing peculiarities of the territory and population served, and also very conspicuously by the training, experience and ability of the men available to fill the various offices and departmental positions.

Except possibly when a new enterprise is organized from the start, it is not expedient, nor always desirable for that matter, to chart a theoretically ideal functional organization

and then arbitrarily select men to fill the positions called for by the chart.

On the contrary, the best practical results are normally obtained by building the organization around the men available, making such modifications in the lines of authority as well as in the titles, as the circumstances require.

In the accompanying charts is presented a composite of the principal functions involved in the operation of an electric railway property. While it is not to be supposed that the minute segregation set forth in the charts will be found in the organization of every company, nevertheless these functions may be said to be common in practically all companies. The difference, for example, as between a small interurban road and a large city system will be chiefly one of degree rather than of character.

The small road has a power supply, trolley wires, cars and track, as has the larger road, although obviously the magnitude and complexity of the problems to be handled on the

small road will be not so great as upon the larger road.

Another distinction between the small and the large road is in the number of assistants through which the department heads execute the work of their departments. While the principles involved are practically the same, the heads of the departments of the smaller company do less through assistants, or have none at all, and they must therefore personally handle much of the actual detail. The same work on the larger road is performed by assistants, while the department heads devote more of their time to supervising and directing and to the determining of general principles and policies.

Frequently many of the functions will be combined under the supervision of one department head. This is particularly true of the engineering departments. The electrical engineer in some instances has charge of both the power department and the track department. Or the mechanical engineer may have track as well as cars and buildings under his

supervision. On some roads one official exercises supervision over all the engineering functions.

In like manner the offices of secretary and treasurer are often merged under one official, who may also be in charge of the accounting or of the purchasing. The superintendent of transportation sometimes has charge of part or all of the engineering.

Here enters the personal equation as well as the opportunity for advancement. The head of the track department, for example, may have shown particular efficiency in the handling of his department. Should a vacancy occur, say at the head of the mechanical department, those in authority may very properly, instead of bringing in a new man, find it desirable to enlarge the responsibilities of the track engineer to include, in addition to his former work, supervision over car repairs.

Some of the functions may also be modified by the increasing tendency to centralize or syndicate the management of small local

companies in what is termed a " holding company"; a creation of modern finance that is rapidly coming into favor, because of the greater convenience and financial stability gained by the issuance of blanket securities covering several detached properties, as against each small company arranging its own individual financing; and because of the more effective results that come through centralized management.

The correlation of all the functions, or departments, into one harmonious and effective organization is probably the crux of successful electric railway management. The best transportation methods that can be devised, for example, and the most scientific of timetables, are of no avail if the cars cannot be kept upon schedule time because of inadequate supply of power, or if the cars are not maintained in mechanically safe condition, or if the track department is lax.

Thus inefficiency in one department may nullify the good work of all the others.

GROUPING THE FUNCTIONS

For the purposes of this analysis the functions may be classified under four groups, viz., executive, transportation, engineering and administrative.

The executive offices are concerned in the broadest sense with the formulation and execution of the company's policies.

The transportation department has direct superintendence over transportation and traffic and the employes involved therein.

The engineering departments are concerned with the physical equipment, as power plant, wires, cars, buildings and track.

The administrative departments are those not directly in charge of the operation of the cars or of the engineering details, but which perform functions, as accounting, purchasing, etc., more or less related to all the departments.

THE EXECUTIVE AND TRANSPORTATION FUNCTIONS

EXECUTIVE

At the head of the organization stand the stockholders or owners of the company.

Actual direction of the company's affairs is usually delegated to a board of directors elected by the stockholders and presided over by a chairman of the board.

It is the function of the board of directors to select the chief executive officers of the company, to shape its larger and more important policies, particularly those relating to financial matters, and in general to see that the affairs of the company are carefully and wisely conducted.

On the larger properties in some instances there is an executive committee elected by the board and constituting in effect a smaller board of directors. In such cases the chairman of the executive committee is usually

the chief executive officer in the management of the company's business.

Next in the line of organization is the president, the duties and responsibilities attaching to whose office vary on different roads, depending upon the policy of organization adopted. In one case the president may serve chiefly as counsellor in the financial affairs of the company. In another case he may be the actual managerial head.

There are usually one or more vice-presidents who may or may not be actively concerned with the operating details.

In every company there is or should be one official who is the recognized directing head of the management, and who, if he does not have one or more of the foregoing titles, is designated as the manager or general manager of the company.

THE MANAGER'S DUTIES

The *manager*, or chief executive officer, whatever his specific title may be, whether chairman, president, vice-president, general

manager or manager, is the man who directs in general the every day affairs of the company's business as a whole. It is to him that the public, the employes and the stockholders look for the results which from their respective points of view seem most important.

As head of the operating force the manager must be qualified not only to advise the different department heads in regard to their problems, but he must see each of these problems in such wide perspective as to coördinate all of the work and reconcile divergent views when such views exist.

It may be said here by way of summary therefore that the chief function of this officer is to make decisions. He must also know that the proper carrying out of these decisions is being attended to by those upon whom rests that responsibility.

The problems confronting the head of an electric railway organization may be broadly classified on the one hand as those relating particularly to the technical side of the business; and on the other hand as those involving

the company's relations with the public and its employes.

The technical duties and qualifications essential thereto are discussed in detail in a subsequent chapter, but in order to gain at the outset a general understanding of the responsibilities attaching to this, the most important position in the organization, it will be instructive to follow through briefly and somewhat informally, what may be termed a manager's typical day's work.

THE MORNING MAIL

The first thing in the day will be the morning mail. This is usually a varied assortment of requests, suggestions, complaints, invitations, reports and correspondence on many subjects. As a usual thing the manager will have a secretary competent to open and classify the mail and distribute to the proper official or head of department such routine letters as do not require the personal attention of the manager. But for the most part the communications coming to the ex-

NEAR SIDE—ENTRANCE AND EXIT AT THE FRONT.

PAY ENTER—PAY LEAVE.

CENTER ENTRANCE.

THE FORERUNNER—NICKEL-IN-THE-SLOT HORSE CAR.

TYPES OF PREPAYMENT CARS FOR CITY SERVICE.

ecutive offices will pass under the eye of the manager even if they do not actually receive his personal answer.

The handling of complaints received from the public and the prompt remedying, where possible, of conditions complained of, are a particularly important part of the manager's responsibilities.

Probably the largest number of letters received from the public relate to the service or to the conduct of employes, and candor requires the recognition that many of the complaints are well founded and are properly laid at the door of the management or its employes. For these complaints the corrective remedy should and must be promptly applied. In other instances conditions beyond the control of the company prevent remedial action and in these cases equal candor requires that the complainant be so informed.

The following is not an artificial list of complaints but is a composite made up from several hundred actual letters, perhaps the most surprising thing about them being the

contradictory character of the complaints. Some of these are:

Complaints against individual motormen or conductors for real or fancied discourtesy or laxity in the performance of duty, and an almost equal number of letters commending the courtesy, tact and good judgment of employes.

Complaints that not enough ventilators are kept open in the cars, or that too many ventilators are kept open.

Complaints that the cars are kept too hot, or too cold.

Protests that the speed of cars is too fast, and equally vigorous protests that the speed is too slow.

Requests that additional stopping points for cars be established, and an almost equal number of complaints that cars make too many stops.

Protests from quiet-loving souls against ringing of the motormen's gongs, and statements from accident witnesses that motor-

men do not ring their gongs sufficiently to prevent accidents.

Requests for, and protests against, smoking on cars.

Requests for, and protests against, the operation of open cars.

The successful electric railway management of to-day studies all of these letters thoroughly and earnestly, for they offer the best possible index to the character and sufficiency of the service supplied to the public. In the modern school of electric railroading the "public-be-damned" fallacy, if it ever really existed, has forever given place to the "public-be-pleased" policy.

From this standpoint the great difficulty is that of reconciling the diversified opinions of the public upon matters regarding street car service.

Upon the question of what constitutes proper ventilation of cars, for example, the desires of passengers will cover both extremes from all ventilators closed to all ventilators open. So with stopping places for cars; one

man insists that cars stop at his place of business or in front of his particular residence, failing to recognize that if his request were granted, the time of all other passengers would be wasted to that extent solely for his accommodation.

Holding cars for passengers at stopping places is another problem wherein the application of the principle of the greatest convenience to the greatest number sometimes apparently conflicts with the granting of any special privilege to the individual. "The motorman deliberately ran away from me while I was hurrying towards the car," is a typical form of complaint involving a factor in the giving of good service about which the aggrieved patron rarely stops to think. Possibly there is in this grievance some lingering memory of horse-car days when the obliging driver was accustomed to "wait a minute" in front of the intending passenger's door. But the electric car and the progress of the communities have changed these conditions.

From the individual's viewpoint it surely

is exasperating, after running a considerable distance for a car, to arrive breathless at the point of stop and see the car draw away with the platform doors closed. But the management is confronted with a very serious difficulty in its endeavor to formulate a rule that will remedy this source of irritation.

An average car line, for illustration, has perhaps one hundred stopping places on the round trip. Some of the longer city lines have several hundred such stops. If the time consumed at each stop is increased only thirty seconds for the accommodation of belated passengers there will be, on a line having one hundred stopping places, a direct loss of fifty minutes,—nearly an hour longer to make the trip. Furthermore, a delay of thirty seconds for the accommodation of one passenger means a loss of this time to all the passengers on the car. The loss in any one instance is small, but in the accumulated aggregate it is sufficient to impair the service seriously.

Another form of protest has to do with cars running by without stopping for in-

tending passengers. Here also there is more behind the situation than appears to the discomforted patron. Unfortunately, blockades to car traffic do at times occur, and it is almost universal that the first cars after a blockade at once become loaded beyond their capacity, while the cars immediately following them have room to spare.

When such a delay occurs it is imperative from the standpoint of good service to the greatest number that the first cars through be restored to the normal headway in the shortest space of time, it being an elementary principle in transportation that the best service to all patrons is assured when the cars are operated closely on scheduled headway.

While it is self-evident that cars must be operated to afford the maximum accommodation and convenience to passengers, the demand for rapid transportation to meet the requirements of life in our busy American communities does not permit of discriminating against many passengers for the unreasonable accommodation of the few. The

holding of a car at a stopping place for the benefit of belated patrons and the restoration of headway after blockades are therefore matters requiring the exercise of courtesy and good judgment on the part of the car crews, and a true concept on the part of the patrons as to what constitutes real public service, *i.e.*, better service to the greater number.

Then there is a group of requests which in any one individual case might be granted, but which would immediately open the door to the asking for similar concessions that would lead to well-nigh impossible situations. For instance, a neighborhood asks that a shelter be provided at an exposed corner wherein prospective passengers may wait for the cars. This in itself might readily be granted, but the precedent would be cited in support of requests for similar shelters at many other points on the system. It manifestly would be impossible to provide such shelters at all points where prospective passengers congregate.

The same difficulty arises in the handling of requests for extension of fare limits, additional transfer privileges, the posting of cards in or on cars for the purpose of advertising public or semi-public attractions, and demands for contributions and donations to associations, societies and individuals for purposes charitable and otherwise.

It would seem, for example, a reasonable thing for the street car company to carry upon its cars without charge signs advertising a charity bazaar. But in a large community events worthy of this privilege are taking place almost daily. To grant even a small proportion of these requests for space would soon result in the cars becoming literally plastered with notices and cards, thereby not only causing an untidy and unsanitary appearance, but resulting in actual confusion to the public because of the multiplicity of signs.

The handling of requests for donations presents a particularly perplexing problem. Whenever an event is proposed, intended to

A MODERN INTERURBAN PASSENGER CAR.

CAR WITH PASSENGER, SMOKING, AND BAGGAGE COMPARTMENTS.

TYPICAL EXPRESS AND BAGGAGE CAR.

ELECTRIC LOCOMOTIVE HAULING FREIGHT TRAIN.

TYPES OF INTERURBAN SERVICE.

attract the public, it is considered wholly legitimate at once to call upon the railway company for financial assistance, presumably upon the theory that the company will profit by the additional riding thus created. In connection with this form of request there is invariably a very greatly exaggerated idea of the profits the company will derive from the proposed event.

THE DAY'S WORK

Having cleared his desk of the mail by dictating answers where immediate answer can be made, or by referring the communications to the proper subordinate or head of department for investigation and report against subsequent answering, the manager will probably devote considerable time to conferences with various heads of departments and to receiving callers who come with many sorts of errands—political, commercial, personal and otherwise.

The manager of the electric railway company is very much a public official and the

public expects and demands access to his private office upon the slightest pretext. The passenger with a grievance, the man with an ax to grind, the woman with a subscription list, the job hunter, the inventor, the salesman, the politician, plain crank and substantial business man alike regard the manager as public property and insist that their particular business be transacted with him personally and not through subordinates. These personal interviews comprise a very considerable part of the day's work.

The manager's luncheon will be taken, seldom alone, sometimes with one or more local or out-of-town callers, but usually with one or more heads of departments; the luncheon period being practically a continuation of the conferences of the morning.

In the early afternoon there will be more calls, more conferences, more reports to analyze, perhaps a few letters to answer, and more instructions to be given.

It has come to be a rather general custom for electric railway managers to devote the

latter half of the afternoon to trips of inspection over the company's system. These inspections may cover track conditions at a particular location, power house, shops, one or more of the car barns, perhaps one of the material store rooms or any one of a score of locations on the property where some condition requires analysis and decision. Frequently the trip will be devoted to traffic and service observation and study.

On these inspection trips the manager will probably be accompanied by one or several heads of departments and subordinate officials; and the time will be filled with discussion and analysis looking to improvement of service, methods and conditions.

As to the manager's evening much depends upon circumstances, individual temperament and the number of assistants to whom he may delegate some of the work. Seldom will he have an evening free from the responsibilities of his position. Many are the local demands upon the electric railway manager, especially in the smaller communities, to speak at pub-

lic meetings and before civic, business and councilmanic bodies, and all of these he cannot refuse.

Nor are the manager's allotted hours of rest wholly sacred; for he is subject to call at any hour of the night because of an emergency, a serious fire, a severe storm or some other interruption to traffic to which electric railway service seems to be peculiarly liable.

Obviously, the foregoing is a composite picture and is not to be taken too literally in any one case. For instance, the manager of an extensive network of interurban lines covering part of one or more states will arrange his program of office work, conferences and inspection trips on a basis quite different from that followed by the head of a large city system, or the manager of a small combined city and interurban system.

But the picture is indicative of the managerial functions and will serve to clarify the later deductions as to the training and qualifications necessary to the successful performance of these functions.

TRANSPORTATION FUNCTIONS

TRANSPORTATION

The transportation department under the supervision of a superintendent, general superintendent or superintendent of transportation, handles the details relating to service. By service is meant the safety, adequacy and regularity of the operation of cars, including the making of time tables.

A transportation department function closely co-related with that of service is the selecting and training of the motormen and conductors, and their discipline, by which is signified all that goes to create and preserve the complete unanimity of purpose and effort between the men on the one hand and the management on the other.

If the road does an extensive freight or express business, or if it is an interurban line competing for patronage with other lines of transportation, traffic getting will be an important function. This will involve methods of personal solicitation, follow-up letters, advertising and other means of convincing prospective passengers and shippers

as to the advantages to be gained by using the facilities offered by the company's cars.

Frequently, especially on interurban roads, traffic getting and handling are functions of sufficient magnitude to require a separate traffic department distinct from transportation.

For operating purposes electric roads are usually divided into geographical divisions, each with its own operating depot in charge of a division superintendent. Much of the time of the head of the transportation department will be spent in supervising and perfecting the important details that are handled at these divisional depots.

The division superintendents under the direction of the head of the department have general charge of transportation matters in their respective divisions. They have authority to discipline and suspend motormen and conductors and to recommend discharge for disobedience of rules; but usually they do not actually hire or discharge men, it now being considered best practice to centralize

this responsibility at the general transportation headquarters.

The division superintendents are also responsible for the proper preparation and forwarding to the general offices of the various required depot reports, as trainmen's time sheets, accident reports, lost and found articles, etc.

The depot constitutes the point of actual contact between the company and the motormen and conductors, in-so-far as their daily work is concerned. Here the men report at the beginning of their day's work and here they make their "turn in" after they have finished their runs. At the depots are handled the details of such matters as choosing runs in accordance with seniority rights, obtaining leave of absence or time off, making up the "extra" list; and here also are administered the penalties for failure to report for duty and minor infraction of rules. All these details have to do with what the men term their working conditions, and the manner in which the depot authority and routine are exercised

has a vital bearing upon the comfort and peace of mind of the men and their attitude toward the company and their work. Hence the importance of proper supervision over depot methods and practices as a factor in the successful administration of the transportation department.

PUBLIC SERVICE AND TIME-TABLES

The electric railway company sells its product, *i.e.*, transportation, very much upon the same principles as the automobile manufacturer sells automobiles or the shoe manufacturer shoes. That is to say, the public utility company is under the same necessity of making its product attractive to the consumer as is the manufacturer. Nor can the transportation company run its business without supplying that which is to be sold with some relation to the demand and to the cost of production any more than can the factory.

Successful electric railway operation consists largely in the close adjustment of car service to the needs of the public. There

should always be sufficient cars on the lines to accommodate the passengers. Cars operated in excess of that number entail a waste, profiting no one. Cars should be so operated as to transport the greatest number of passengers between the points of travel by the most direct routes, with dependable regularity, and at the highest rate of speed consistent with safety.

These are the service standards towards which progressive transportation managements are striving.

Without here attempting an analysis of time-table making it may be said that as the basis of schedules or time-tables, studies of the traffic conditions are prepared including the probable number of passengers desiring to ride at each hour of the day, on the different days of the week, and at various seasons of the year.

After this information is tabulated the number of trips necessary to take care of the traffic is computed. Then in conjunction with length of line and speed factors the re-

sults are converted into car runs, then into crew runs, and finally into completed traffic or time-table statements. As traffic conditions change from time to time the schedules must be changed.

In the making of time-tables the transportation department is also confronted with the double problem of plotting the schedules so that they will be satisfactory alike to the traveling public and as regards the hours of work to be performed by the motormen and conductors. This would not be difficult of accomplishment were there no peak or rush hour periods, but when, as is frequently the case, there is need for 100 per cent. more cars on the street from 6 to 8 in the morning and from 5 to 6.30 in the evening than there is during the intervening hours, the proper adjustment of the schedules and the runs approaches the importance of a science.

THE MOTORMEN AND CONDUCTORS

It is not within the scope of this book to review or add to the mass of discussion upon the overshadowing topic of capital and labor.

Like all other really great problems of the day, the process of adjusting the relations between the man with money for hire and the man with labor for hire is an evolution, the consummation of which will be reached only when fundamental truth and right are understood, universally recognized and applied.

Under present conditions, that relation which is best expressed by the term " coöperation "—each fellow giving the other fellow a square deal—forms the one basis upon which utility companies and their employes can get together; and it is through coöperation that improved service to the public, increased wages and improved working conditions to the men, as well as increased returns to the company, can be most definitely assured.

This principle of coöperation and square dealing properly extends into all the relations existing between the company and its employes and shapes the policies and methods followed in hiring them, in training them for their work, in the administration of disci-

pline, and in their final discharge if that becomes necessary as the last resort.

As regards discipline, for example, the cooperative method recognizes that it is easy enough to discharge a man, but that a more laudable service to society as well as to the individual has been accomplished if, by caution and instruction, a man's faults can be corrected before the necessity for his discharge arises. As one of the many applications of this principle, it therefore follows that only such rules should be in force for the guidance and government of motormen and conductors as are essential to the protection of the public and the proper operation of the cars, and that the penalty for violation of any rule should be no more severe than is required to discourage a repetition. Browbeating, petty bossism, vindictiveness, favoritism and discrimination have no place in modern methods of dealing with employes.

The significance of this whole broad question of "hiring and firing" as a factor in successful business management has only re-

cently been recognized but there is now a widespread awakening to the fact that this subject is deserving of detailed study and is possessed of surprising possibilities for improvement and development.

Because of its importance in electric railway management the following summary is given indicating the procedure adopted by practically all railway companies in the employing and training of their transportation employes. Practice may differ as to details, but in the main certain fundamental principles are almost universally recognized.

An applicant for the position of motorman or conductor is usually first received by an employment clerk or other subordinate official who asks a few preliminary questions, such as name, age, address, former experience and reason for leaving previous employment, in the meantime sizing up the candidate as to general appearance and qualifications.

Most companies have certain general requirements as to age limit, height and weight,

and if the applicant meets these regulations and shows general evidence of becoming a capable employe, he is given an application form to fill out. This form is designed to reveal the man's general qualifications, habits, family history, health, references and previous experience.

The applicant's statements are then subjected to rigid investigation. By correspondence or interviews with his previous employers and references, every effort is made to establish the man's character, habits and reputation; for this is an occupation calling for clean, honest, earnest men.

If the candidate passes this preliminary investigation he is given a thorough medical examination for physical fitness, especially as regards eyesight and hearing.

He is also put through certain psychological tests to determine his general intelligence, quickness of perception, imagination, courtesy, general education, and other qualifications necessary to this work.

At some stage of these tests the applicant

usually comes under the direct observation and examination of the head of the transportation department for decision as to acceptance or rejection.

Having qualified mentally, morally and physically as being the kind of man the company desires to have in charge of its cars, the candidate starts upon his course of instruction.

The specific instruction for this calling covers all the varied duties of motormen and conductors in their relation to the public and to the company. It includes a thorough explanation of the construction and use of the company's car equipment, controllers, air-brakes, circuit-breakers and other devices with which the trainmen must be familiar. It involves an understanding of the company's rules for the courteous treatment of the public, the requirements of safe and careful operation of cars, and the regulations as to fares, transfers, etc. Of course actual experience upon the road under the tutelage of competent instructors is an essential part of the training.

If the candidate shows continued aptitude under instruction he is finally accepted as an employe and placed at the foot of the extra list, as it is called, *i.e.*, he is assigned in his turn to operate tripper or extra cars, or to work in the place of regular men who may be absent from duty.

While the probationary term of instruction takes from two to four weeks, the making of what might be termed the 100 per cent. motorman or conductor covers a long period and is really never finished; for the right kind of an employe is never through learning and is never satisfied to say there is no more room for improvement.

It is the leading tenet in the code of principles of this business, that "the first obligation of public utilities engaged in transportation is service to the public, and the first essential of service is safety." This doctrine should govern the attitude and conduct of the motormen and conductors as well as of the executive officials.

Transportation employes are engaged in a public service in which they are constantly

called upon to exercise the greatest patience, forbearance and self-control. They are subject at times to annoyances and unreasonable treatment from passengers, but their position requires that under such circumstances they avoid controversy and complaint by keeping their temper, saying as little as possible, and meeting the situation with politeness and courtesy. Uncivil or profane language finds no place in the vocabulary of the careful transportation employe.

The man desiring to remain in this calling will be temperate in all his habits and will conduct himself in accordance with the rules of clean and decent living, to the end that he may at all times be prepared to meet the responsibilities of his position with that alertness and keenness essential to safe and effective operation. The spirit of coöperation does not lend itself to unseemly conduct, or to any act detrimental to the company's interests, either when on or off duty.

The man in charge of an electric car can have no use for intoxicating liquors. Booze and electric railroading do not mix.

THE ENGINEERING FUNCTIONS

For the purpose of this analysis the engineering functions in electric railway work are divided into three main groups,—viz.:

ELECTRICAL, embracing power generation and power distribution.

MECHANICAL, which embodies the construction and upkeep of cars and rolling stock, including supervision over repair shops and car houses.

CIVIL, which covers the construction and maintenance of what is termed the permanent way, *i.e.*, road-bed, track and roadway structures.

There is also the item of construction and maintenance of buildings which, technically, is a branch of civil engineering, but is sometimes, for expediency, placed under the supervision of the mechanical department.

While these primary divisions represent distinct classes or engineering work, they are intimately inter-related and in the daily rou-

tine they touch at many points. For example, the design and condition of the apparatus on the cars, as motors, gearing, controllers, electric heaters, incandescent lamps, etc., all of which are under the supervision of the mechanical department, effect directly the demands made upon the electrical department. On the other hand, the operations of the electrical department as represented by the regularity of the power, the voltage delivered and various conditions of power generation and distribution, have a bearing upon the maintenance and efficiency of the apparatus on the cars.

The mechanical and track departments must work in close coöperation, because, for illustration, the shape or contour of the tread and flange of the car wheels, weight of car, and other factors associated with the rolling stock, largely influence the type, life and up-keep of the rails and track special work; and, conversely, track conditions effect the life and smooth running of the cars. Likewise, the track and electrical departments

share many problems in common. For example, the track department usually is responsible for the installation and maintenance of the bonding at the rail joints, forming the return circuit for the electrical current; and the efficiency of this return circuit is an important factor in the effectiveness of the power department.

To cite another single illustration of how these problems present themselves, the question of the relative hardness of the trolley wheel and the trolley wire is typical. The mechanical department is desirous of using trolley wheels made from the hardest available composition so that the life of these wheels may be prolonged to the greatest possible maximum. But the trolley wheels can be made so hard as to cause excessive wear of the trolley wire. Thus it might come about that while an excellent showing is being made in the low cost of trolley wheel renewals, proportionately larger expenditures are necessary for the maintenance and renewal of the overhead wire construction. There is a deli-

cate balance between the right hardness for the trolley wheel and the right hardness for the trolley wire, and some one in authority must be able to analyze the pros and cons of the problem and decide upon specifications both for the trolley wheel and the trolley wire that will give the best results from the broad viewpoint. These are only a few of literally hundreds of similar problems.

Theoretically, at least in the larger companies, the ideal organization of the engineering functions would call for a chief engineer, reporting directly to the chief executive officer. To the chief engineer would be delegated the responsibility of supervising all the engineering functions, including those relating to power supply, wires, cars, tracks and buildings. Reporting to the chief engineer there would be an engineer or departmental superintendent in charge of each of these five divisions of the work; each of these department heads to have jurisdiction of construction, maintenance and operation in the respective department.

In practice, the title chief engineer is frequently found but it does not always represent this comprehensive responsibility. In some companies the chief engineer is in charge only of the power house. In other instances the title is used to designate the officer in charge of track. Sometimes the chief engineer combines two or three of the engineering branches, and in some organizations he fulfils the ideal theory and has supervision over all engineering details.

If the organization does not provide for a chief supervising engineer in this broadest sense then this responsibility, as final adjustor in engineering matters, must be exercised by one of the executive officers whose experience must be broad enough and whose angle of vision must be sufficiently wide to secure the best net results in the operation and development of the property as a whole. In the making of these decisions there must be brought to bear a practical combination of business and technical ability.

The designation "superintendent" in-

stead of "engineer," in the titles assigned to the men in charge of the engineering departments, is coming into favor chiefly because the title superintendent carries with it the thought of responsibility for departmental administration, in addition to supervision over the strictly engineering details. Hence such titles as superintendent of motive power, superintendent of rolling stock, and superintendent of way are in frequent use.

Labor and material constitute the two elements with which the engineering departments are continuously concerned, for reduced to its elementary terms, every engineering operation, from the simplest to the most complex, is a process of changing either the form, character or location of materials, in which process, labor must be applied either direct or through the agency of tools or machinery.

The labor problem as it presents itself to the engineering departments has to do with the hiring and training of skilled and unskilled workmen, the planning and directing

of their efforts, the adjustment of their wages and the betterment of their working conditions; and there is the same need for the application of the principles of coöperation and mutual square-dealing between employer and employe in these departments as there is between the transportation department and the motormen and conductors.

Corollary to the handling of labor, the application of a knowledge of materials, their uses, their costs, and the operations and processes by which they are brought together to accomplish useful purposes, plays an important part in all branches of engineering.

The following indicates some of the chief functions specifically performed by the engineering departments in electric railway work.

ELECTRICAL

The electrical department is responsible for the safe, continuous and economical generation and distribution of electrical energy. Its work is highly technical and specialized.

THE ELECTRICAL DEPARTMENT IS RESPONSIBLE FOR THE REGULARITY AND SUFFICIENCY OF THE POWER SUPPLY.

THE ENGINEERING FUNCTIONS

The usual electric railway power supply involves one or more central stations or power houses where the electrical power is manufactured; transmission lines over which it is transmitted; sub-stations where the current is changed to the required voltage and character; feeder wires whereby the power is distributed to the lines in the vicinity of each sub-station; trolley wires from which the energy is fed to the motors, air-brake compressors, heaters and lamps on the cars; and the return circuit whereby the current is conducted back to the sub-stations. All this requires complicated machinery, apparatus, instruments and an intricate network of underground and overhead wires and cables.

The power equipment and wires are under continuous and severe mechanical and electrical stresses and require constant expert supervision and attention to insure continuity in the power supply. Eternal vigilance is therefore peculiarly the keynote of this department, for if the power is interrupted the car service stops, schedules are thrown into

disorder and the public is given cause for dissatisfaction.

Next to insuring reliability in the supply of power, the department is concerned with securing a high degree of economy and efficiency in the production and distribution of the power.

As this treatise is not intended to encroach upon the field of the technical text-book no attempt will be made to enlarge upon the technical problems with which the electrical department has to deal, but it will not be amiss to indicate, briefly and in general, a few of these problems as they relate to the design, construction, maintenance and operation of the steam plant, the electrical and power equipment, and the system of wires and cables. These comprise the three main groups of elements, over which the electrical department has supervision.

Electrical energy is produced by dynamos or generators, actuated by some form of prime mover,—viz., either reciprocating engines or rotary engines called turbines.

Steam to drive these engines or turbines is produced in boilers under which coal is ordinarily burned as fuel. Under exceptional conditions, boilers are designed to burn other combustibles, as wood, sawdust, oil or various forms of gas. In localities where coal is scarce and water power is available, water driven turbines are extensively used.

The problems arising in connection with the steam production end of a power plant have to do with scientific boiler room practice; boiler design; economizers; superheaters; forced draft; coal and ash handling machinery; smoke prevention; flue gas analysis; prevention of boiler scale, and similar factors. The specifying of the proper grade of coal is a particularly important item, and studies of the cost of producing power must be made at frequent intervals to determine the quality of coal best adapted to the conditions at the particular plant, and for balancing the steaming efficiency of various grades of coal against their cost.

In connection with the prime mover and electrical part of the plant, the department deals with the design, capacity, efficiency, up-keep and operation of reciprocating engines; high and low pressure turbines; generators; switchboards; controlling and measuring instruments and devices; condensers and water cooling equipment; and various forms of auxiliary apparatus, as pumps, air compressors and blowers.

In the direction of safety, studies and investigations are constantly being made to prevent accidents to employes and other persons, and to avoid short circuits and shutdowns. From the standpoint of economy, such questions arise as how to improve the power station load factor; best methods of handling peak loads and utilization of power station by-products.

As regards power distribution, consideration must be given to determining and reducing transmission losses; balancing distribution losses against the cost of electrical conductors; securing the highest efficiency and

reliability in sub-station practice; testing, inspecting and repairing overhead and underground cables in order to forestall breakdowns; securing greatest protection against damage by lightning; and protection of water pipes and other underground structures from damage by electrolysis.

From the general standpoint of departmental management, such questions arise as relate to power accounting, cost analyses, and organization and methods with reference to the clerical, drafting, construction, repair and operating forces.

If a laboratory is maintained for making chemical and other analyses and tests of metals and materials, for convenience it is usually placed under the supervision of the electrical department.

Every growing electric railway is perpetually confronted with the necessity for providing an increased power supply, and this power demand must be anticipated and calculated a considerable period in advance. The responsibility for such estimating and pro-

viding for future power requirements are important functions of this department.

MECHANICAL

The primary function of the mechanical department is to keep the cars of the company in a safe and efficient state of repair.

Including each individual bolt, nail, screw, piece of hardware and the component parts of the trucks, car body and equipment, the average trolley car is separable into more than twenty-six thousand distinct parts, involving the use of wood, steel, glass, brass bronze, aluminum, nickel, lead, glass, rubber, asbestos, mica, leather, rattan, porcelain, linen, wool, cotton, tungsten, resin, beeswax and perhaps twenty other basic materials or their compounds.

This bit of information would in itself be interesting only in the abstract, but considered as an illustration of the need for organization of men, of materials and of methods, it is highly enlightening.

Before a car is permitted to start from

THE PRIMARY FUNCTION OF THE MECHANICAL DEPARTMENT IS TO KEEP THE CARS IN A SAFE AND EFFICIENT STATE OF REPAIR.

the car house upon its day's run, some one must know that each individual piece and part of the car is in its proper place and in a state of good repair. A projecting nail may catch and damage the clothing of a passenger or even cause bodily injury. A loose floor board may cause a passenger to trip and fall. A screw missing from a grab handle may cause a person to be thrown to the street with serious results. Brakes, controllers, fenders, motors, and all other mechanism must likewise be in safe operative condition.

This means that there must be a force of trained men, so organized and supervised, that there will be no possibility of a car being sent from the car house into service until after a thorough inspection has been made and all loose, broken or missing parts repaired or renewed.

A complete stock of the necessary materials and parts must always be kept on hand. Whether it be a specially shaped angle bracket at the corner of a seat, the pinch handle on a curtain, or the smallest bolt in

the air-brake mechanism, if any part is broken or missing, there must be another one quickly available to take its place.

Finally, there must be a coördination of methods, or system, such as will ensure effective results.

In all this work many trades are involved.

The inspection and repair of car bodies, trucks, wheels, axles, gears, pinions, bearings, air brakes, hand brakes, motors, controllers, wiring, fenders, etc., require carpenters, cabinet makers, painters, glaziers, blacksmiths, metal workers, foundrymen, pipe workers, machinists, armature winders, electricians and general repairmen, the last named representing a new and distinctive trade in itself for which the name " electric car mechanics " has been suggested.

In addition to the maintenance of cars, but closely correlated therewith, the head of this department performs two other principal functions. One of these has to do with the designing of cars and car parts and the other with supervision over the repair shops.

The originating of new car designs, and the improving of car equipment, are here mentioned as important elements because the electric car is still in a state of evolution. Any one who has given thought to the subject must have been impressed with the changes that have taken place, even within the past decade, in car types, and the wide differences that exist in different localities as to appearance and general design of electric cars.

Earnest efforts have been made to agree upon standards of uniformity in this respect, but the continued endeavors of individual companies to develop new designs in order to provide the greatest safety and accommodation to the public have resulted in so many improvements and new principles, that it is not yet possible to speak of a standard electric car.

Perhaps the most conspicuous changes made in car design during the past few years have been those brought about in connection with the development of the prepayment fare

system; by the almost universal adoption of the enclosed car platform for the purpose of preventing passengers from boarding, leaving or falling from, moving cars; and by the effort so to locate the exits and entrances as to insure the greatest safety and convenience to passengers. Two of the latest examples of this evolution are the near-side type, wherein both entrance and exit are by way of the front platform, and the center door type, in which both entrance and exit are at the center of the car. These types and their variations illustrate the effort to secure lower car steps, wider aisles, greater seating capacity, more adequate ventilation, better sanitation, elimination of needless weight, reduction of noise, improved safeguards and accident preventing devices, and improved facilities and comforts for the motormen and conductors.

The mechanical department is not alone charged with the responsibility of keeping up this progress in improved car designs, for the suggestions come from all departments.

But upon the chief mechanical officer does fall the duty of taking all the ideas, including his own, and working them out to tangible and practical conclusions.

The inter-department organization of the mechanical department varies with the number of cars and type of rolling stock. Usually the heavier repair work, general overhauling and painting of cars is concentrated at a central repair shop, while the daily inspections of cars and the lighter repair work are performed at car houses conveniently located at different points on the system.

The supervision of various processes of manufacture at the repair shops is a function of importance, because of the large proportion of the company's expenses involved therein.

While electric railway companies buy most of their supplies and materials from specializing manufacturers and dealers, there are many articles of special design that can be advantageously made in the company's shops. Then, too, shop facilities adequate to care for

the heavy repair work on cars are necessary in any event, and these involve certain fixed expenses for plant and supervision. In order to provide what is termed a good load factor for the shop, it is found economical to manufacture in this plant many of the things the company requires.

The modern electric railway repair shop has therefore come to be a complete manufacturing plant, turning out a wide variety of products. Although these products are intended for the company's own use in the carrying on of its own business, the work calls for the application of the same principles of scientific management, efficiency, cost analysis, records and shop equipment as are necessary in any modern factory.

As indicating a few of the many specific topics with which the mechanical department is concerned the following are cited: car equipment maintenance and inspection; care of car motors; air-brake design and maintenance; composition and shape of brake shoes; life and care of car wheels; lubrication of

bearings; care and maintenance of car bodies; car painting and varnishing; heating and ventilation of cars; repair shop design; shop practices; shop tools and equipment; operating and storage car house designs, etc.

The thorough cleaning of cars, now recognized by progressive managements as a most important part of the routine work, is sometimes placed under the supervision of the transportation department, but more frequently it is made a function of the mechanical department.

As in other lines of industry, the automobile is coming into extended use by electric railway companies for various purposes, as, for expediting the work of the heads of departments and their chief assistants when on inspection trips or other company business. Automobile trucks of special designs are employed as wrecking and line repair vehicles, for the delivery of materials, for hauling stone, sand, gravel, etc., and for handling freight and express. On the larger roads, the maintenance of this fleet of autos is an im-

portant item and requires a thorough knowledge and application of automobile engineering. This work falls naturally under the supervision of the mechanical department.

CIVIL

The track or way department performs those functions commonly but broadly classified as civil engineering, although other branches of engineering knowledge, including in particular some phases of applied mechanics, enter into its work.

This division of the electric railway organization is responsible for the construction, maintenance and renewal of the track, roadway and track structures; and for the development of improvements and refinements in track designs, materials and methods.

The following are some of the topics to which the department is constantly giving its attention: Composition of rails and processes of manufacture as factors in the life of rails; designs of girder and T-rails in their relation to wear, paving, and street traffic; design and composition of track special work,

THE WAY DEPARTMENT HAS TO DO WITH THE CONSTRUCTION AND REPAIR OF THE TRACK, INCLUDING PAVING, BRIDGES, AND ROADWAY STRUCTURES OF MANY SORTS.

switches, mates, frogs and crossings with reference to the life of car wheels and track; design and renewal of sundry track materials, as track spikes, bolts, tie rods and tie plates; preservative treatment of ties; the use of concrete and metal ties in substitution for wood ties; design and maintenance of rail joints; modern cast joint and electric welding processes; rail bonding; causes and prevention of rail corrugations and rail creeping; and kindred topics affecting the safe and economical construction and maintenance of track.

Track foundations to secure the maximum permanency, freedom from vibration, and noise-reducing qualities are receiving especial attention from progressive managements. Analysis and experiments along these lines include consideration of the ballast; proper drainage, which involves drain-pipe and sewer practice; ditch and culvert construction; weed destruction; and the determination of bearing power of soils with reference to supporting track foundations.

Modern street and road paving has an important place in electric railway track work; and the way department is always confronted with problems involving the life and relative cost of granite, wood, brick, macadam and other types of pavement and paving foundations in connection with track construction and maintenance.

In designing track and methods of track installation and repair for use in public streets and highways, the general character of the location where such installations are to be made must be kept constantly in mind, to the end that there be as little interference as possible to the use of the thoroughfares by pedestrians and vehicular traffic.

Bridge and trestle designing and their construction and maintenance are usually functions of this department.

Bearing upon the management of the department as a business, the routine includes geographical and departmental organization of labor gangs and supervision over their work; the keeping of track records and cost

analyses; the making and recording of surveys; and the making of estimates of cost of proposed new and renewal work.

BUILDINGS

Buildings for many purposes are necessary in electric railway operation,—viz., power houses, sub-stations, repair shops, car houses, offices and employes' quarters, waiting rooms, passenger stations and shelters, freight or express stations and terminal facilities.

The number, size and design of these buildings will vary with the size of the road and the character of the business done, but even on a small road the work of designing, constructing and maintaining buildings requires expert and efficient attention.

In the construction and repair of modern buildings, many specialized phases of engineering must be applied. Concrete construction is now extensively used and concrete engineering has become an important factor in the work of the electric railway engineer.

Fire protection, embracing the scientific

application of fire resisting materials, limiting areas of exposure to retard the spread of fire, automatic sprinkling systems, systematic inspection to insure cleanliness, and the use of modern devices and methods for preventing and extinguishing fires, is another specialized science that has come to be a recognized branch of this business.

Heating, lighting, ventilating, plumbing and sanitation are included in the list of sciences and trades which must be drawn upon by the department having the care of railway buildings and structures in its charge.

The use to which the building is to be put is the paramount consideration in designing structures of this character, but it is particularly worthy of mention that good architecture is a distinguishing feature of modern electric railway buildings. The spirit of public service is displayed in attractively appearing power houses, sub-stations, shops, car houses and office buildings.

GOOD ARCHITECTURE IS A DISTINGUISHING FEATURE OF MODERN ELECTRIC RAILWAY BUILDINGS. THE SPIRIT OF PUBLIC SERVICE IS DISPLAYED IN ATTRACTIVELY DESIGNED POWER HOUSES, SHOPS, AND CAR HOUSES.

THE ADMINISTRATIVE FUNCTIONS

SECRETARY

The duties of the secretary are primarily corporate in their nature, *i.e.*, they have to do with the official affairs of the company in its capacity as a legal corporation. The secretary is custodian of the company's official seal which he affixes to all documents that require sealing after they have been approved by the designated officials. He is usually authorized to execute jointly with the president or other accredited official all legal documents as contracts, agreements, leases, deeds, mortgages, etc.; and he is charged with the responsibility of checking, verifying, filing, indexing and safe-keeping the official papers, documents and records of the corporate acts and transactions of the company. The secretary keeps the minutes of meetings of the stockholders and board of directors; issues the stock certificates of the company; keeps

the stock ownership and stock transfer books; and sends out the legal notices of regular and special meetings to the stockholders and directors.

One of the functions of this office is to keep a record of the expiration dates of contracts, leases, options, etc., and to send advance notices of such expiration dates to the officials or departments concerned, in time to permit the reaching of decisions as to the renewal or discontinuance of agreements, or the exercise or rejection of options.

Frequently, the secretary performs other duties as prescribed by the president or manager; as for example, the secretary is often also the purchasing agent.

The duties of secretary carry important responsibilities and he must merit and be given a high degree of trust and confidence.

TREASURER

The treasurer receives all moneys paid to the company from whatever source and deposits them in a designated bank or banks;

which funds can usually be drawn out only by check of the treasurer, countersigned by the president, auditor or other authorized official.

The sources of revenue of an electric railway company are fares paid on the cars or through station agents; receipts from express, freight, mail, chartered cars and other traffic; rentals and sales of company property; sale of power; receipts from advertising in cars and stations; income from securities owned by the company and its subsidiary and allied corporations; and revenue from issues of stock, bonds, notes, trust certificates or other securities.

Disbursements by voucher are made by the treasurer, after approval or authorization by the proper officer or officers, for materials and property purchased; for labor performed; in payment of claims for accident and other damages, and for taxes, interest, dividend and repayment of moneys borrowed.

On many roads one of the principal routine

functions of the treasurer's department has to do with counting, checking and safeguarding tickets, transfers, etc., sold by and received through the conductors and other agents, although in some instances the clerical work of counting tickets may, as a matter of convenience, be handled by the auditing department.

Another important responsibility exercised by the treasurer's office is the disbursement by cash in pay envelopes, or by check, of the daily, weekly, semi-monthly and monthly pay to the various classes of employes.

The treasurer is custodian of the securities, notes and other evidences of indebtedness due to the company and its subsidiaries; and he sees that payments of interest, principal, dividends, rentals, etc., to and by the company are made when due.

The treasurer is charged with the duty of maintaining sufficient cash balances to meet accruing liabilities; and for this purpose must keep himself informed of the advance cash

requirements for the payment of current bills, invoices, payrolls, etc., on account of ordinary as well as extraordinary items of construction, maintenance and operation.

To avoid unnecessary duplication of bookkeeping, it is the general practice to centralize so far as possible all accounting in the auditing department; and the treasury department therefore keeps, subject to audit by the auditing department, only such books as are directly identified with cash receipts, cash disbursements and bank balances.

In the majority of electric railway organizations the offices of secretary and treasurer are combined under one official.

ACCOUNTING OR AUDITING

The term accountant properly describes one who is competent to design and control the systems of accounts required for the record of the transactions of a business.

An auditor is also an accountant but with the added qualification of being, as defined by Webster, "a person appointed and au-

thorized to audit or examine an account or accounts, compare charges with vouchers, examine parties and witnesses, allow or reject the charges and state the balance."

The term auditor or general auditor therefore well defines in principle the functions of the chief accounting officer of an electric railway company.

The auditor keeps the company's account books, but he is much more than a bookkeeper. It has well been said that the difference between the auditor and the bookkeeper is as the relations existing between the architect and the draftsman, or between the bank cashier and the bookkeepers of the bank. That is, by the accurate, skilful and intelligent analysis of the company's receipts and expenditures, the auditor interprets the financial condition of the company and makes available the information upon which the management largely relies in judging the efficiency of men and methods in all departments.

The functions of the auditing department

specifically include the keeping of the general account books of the company; posting and balancing the journal and ledger entries; checking and recording vouchers and invoices; verifying accounts receivable and accounts payable; auditing the receipts from passenger, freight and other sources; posting, extending and balancing the pay-rolls; distributing to the proper accounts and subaccounts all disbursements for labor and materials; keeping inventories and records of material and supplies stock; and preparing and compiling statistical and analytical data pertaining to each and every one of the company's operations and activities.

In many instances, notably in the larger corporations, it is desirable to affect a control of the closely allied duties and functions of the auditor's and treasurer's offices. This centralized direction or control is often lodged in an official designated as controller, or comptroller, under whose jurisdiction is sometimes also placed the secretary's office. A comptroller in general cor-

responds to an auditor with this larger executive power.

The specific responsibility of the comptroller is to translate into accounting or financial terms the manifold results of operation, of contractual obligations undertaken, and of the general corporate policy or plans of the management such as the preparation of budgets for operating and capital requirements, and estimating the income and expenses for future periods. This position of financial control is in some cases assigned to a financial vice-president.

CLAIMS

The handling of accident claims in connection with electric railway management has of necessity been developed almost to the degree of a profession or science.

If the concern of the electric railway company were only to settle legitimate claims arising from accidents for which it is legally liable, claims adjusting would not be the conspicuous feature of the business it now is.

But unfortunately there has come to exist in the minds of a certain few a belief that the treasury of the electric railway is fair prey for anyone who can find or manufacture any grounds for filing an accident claim; and the degree of exaggeration practiced in such cases, amounting frequently to the alleging of damages from accidents that never occurred, would startle the most prejudiced critic could the aggregate of these claims be computed.

Contrary to popular belief the present day electric railway company stands ready to pay promptly all damage claims that are fair and just under the law. If this fact were generally known and recognized by the public, there would be less for the claims department to do and more prompt settlements of proper claims; but because of the exaggerated and fraudulent attacks upon its treasury, the average electric railway company has been forced into a position of defense and self-protection in these matters.

The function of the claims agent and his department is to determine and adjust the

legitimate claim but to act as the bulwark between the company's treasury and the illegitimate claim for damages.

As regards the duties of the claims agent, supreme importance attaches to the investigation of accidents for the purpose of determining all the pertinent facts.

The statutes and court decisions covering these matters are complicated and involved. For instance, the basis of compensation in the case of a pedestrian struck by a street car at a street crossing is wholly different from that controlling if the pedestrian is struck while crossing the street between street intersections. Likewise a passenger's right of recovery if injured when entering or leaving a car may depend upon whether or not the car was in motion at the time the accident occurred.

The first step therefore is to establish by investigation all the facts in connection with the accident. This is done by interviewing all the witnesses whose names are secured by the car crew, and any one else who can throw

light upon how the accident happened. The efficiency of a claims agent and his department is measured very largely by this ability to locate witnesses and secure accurate and reliable information bearing upon the accidents in which the company is in any way involved.

Having completed the investigation, the next step is to determine if the claimant is entitled to compensation and if so the amount to be paid. It is evident no hard and fast rules can be laid down for determining the fair and reasonable value of an accident claim. The extent of injury, the degree of contributory negligence and the extent of liability under the controlling laws are all factors that must be considered in attempting to reach a settlement.

In some instances, when the investigation shows that the company is not liable in law, or when there is a difference of opinion as to the extent of injury or liability, or when the demands for money damages are so exaggerated and unreasonable as to prevent an

amicable adjustment, it is necessary to resort to a court trial to determine these questions.

The organization for handling cases that have reached this litigation stage differs with different companies. On some roads these are handled by the claims department under the claims agent. On other roads there is a separate legal department or department of litigated cases.

An important responsibility of the claims agent is the recording and preparing of statistics relating to accidents and their causes.

"Safety-first" work, or the systematic and scientific prevention of accidents, is now a thoroughly recognized industrial movement in which electric railway companies have enthusiastically enlisted. This work, both as regards the waging of "safety-first" campaigns to secure the coöperation of the public in the prevention of accidents, and as regards the educating of the company's employes in the direction of reducing accident hazards to themselves and the public, is often placed under the supervision of the claims agent.

PURCHASING

To the uninitiated, the quantity and diversified character of the material and supplies involved in running an electric road are almost unbelievable. On even a small road, the different items of material may exceed ten thousand separate and distinct kinds of articles; and these will range from pins and pens for the clerical force up to steel rails, copper wire by the tons, power plant machinery and completed street cars.

The purchases are further complicated by the fact that many of the items represent wide varieties of sizes and designs of the same kind of article; as for illustration, one company in the course of a year purchased about half a million machine bolts, classified into three hundred different shapes and sizes; several hundred thousand lock washers in nine designs; tons of fire brick in twelve varieties; files by the gross in twenty-five sizes; thousands of brooms in twelve grades; and so on through a list of articles, the use of many of which, in connection with the operation of

an electric railway, would scarcely occur to the average layman's mind.

Some of the articles are common to all departments and some pertain to the work of only one department. Should each department itself attempt to purchase the materials required by it, there would be endless confusion, duplication, wide divergence as to price and much time and energy lost.

For this reason the responsibility for the purchasing of all materials is usually centralized in a purchasing department, upon which the other departments make requisition for the supplies they require.

The tendency in modern purchasing methods is to buy coal, oils, paints, varnishes, copper, brass, iron, steel and other materials and metals, as well as manufactured articles, not upon guess work, but in accordance with definite specifications based upon the most careful analysis and test to determine their fitness for the specific use to which they are to be put.

While these specifications are usually prepared by the respective departments, subject to the approval of the management,—and although the purchases must be circumscribed by the specifications,—this does not limit the purchasing agent in making recommendations founded upon his knowledge of markets and prices; nor does it curtail his taking the initiative in suggesting new designs, new specialties or new materials that may come to his attention.

Effective purchasing is not merely a matter of price, for questions of safety, cost of maintenance, resistance to wear, saving in weight, and other considerations are recognized in arriving at the relative value of a purchase in distinction to price alone. The lowest priced article is not always the cheapest in the long run. For example: Car wheels made of cast iron might be purchased under normal conditions at a cost as low as say $8 each, while steel wheels would cost $18 each; but the life of a cast iron wheel may be but 10,000 miles, while the steel wheel

may give as high as 80,000 miles. Unless there are other factors having a bearing upon the situation, it would therefore probably be better economy at these relative prices to buy the steel wheels even at the higher first cost.

The primary function of the purchasing agent is to buy the materials and supplies required upon the best terms obtainable, as to price and quality, and it is his duty to secure bids from manufacturers and dealers, place the orders, handle correspondence relating to purchases, interview salesmen, collect and study manufacturers' catalogs, follow up deliveries and in general attend to the details of buying whatever in the way of materials and supplies the company needs to buy. He may or may not have charge of the handling and disbursing of materials after they have been delivered.

Another duty that is usually assigned to the purchasing department is the selling of scrap, including worn-out and discarded material.

MATERIAL AND SUPPLIES

After the purchases have been made, the storing, safe-guarding and issuing of the material are functions of no insignificant proportions. The logical place for these functions in the company's organization has not as yet been thoroughly standardized; but the need for a material and supplies department under a general storekeeper is generally recognized by electric railway managements. On some roads the storekeeper is under the supervision of the auditor; on others he reports to the purchasing department; and in some organizations the function is considered of sufficient importance to warrant placing the storekeeper under the direct authority of one of the chief executive officers.

Carried to the highest degree of segregation, this department is charged with the responsibility of keeping record of all stock; making requisitions upon the purchasing agent when a stock is to be replenished, and receiving, storing, issuing and in some cases delivering the materials and supplies used by all the departments.

MISCELLANEOUS FUNCTIONS

In addition to the aforementioned functions there are many special duties arising in the routine of electric railway administration which are either assigned to one or more of the regular departments, or are handled by special representatives or by outside experts. Some of the more important of these functions are as follows:

GENERAL COUNSEL

It is the usual practice to retain, either as head of the company's law department or in an independent capacity, one or more lawyers to advise the management and department heads, when and as required, upon matters involving legal questions; and, if the company does not regularly employ special trial attorneys, to act as its attorney in the preparation and trial of cases when the corporation sues or is sued.

MISCELLANEOUS FUNCTIONS

CONSULTING ENGINEER

Likewise, a consulting engineer or firm of engineers is frequently retained to advise the management in important engineering problems. Usually the regular engineering departments handle routine details; but when some unusual project arises, as the building of a new line, the remodeling of the power supply or distribution system, or when some special study involving operation is to be made, *e.g.*, a general analysis of traffic conditions, the re-routing of lines, mitigation of electrolysis, and so on, it is found expedient to call in a consulting engineer or firm of reputation and experience to supplement the company's own engineering forces.

RELATIONS WITH THE PUBLIC

The creating and maintaining of a spirit of good will and coöperation between the company and the public it serves has in recent years come to be recognized as a vital element in successful management. Most electric railway organizations therefore have a

representative, frequently designated by the title publicity agent, who assists the chief executive officer in handling publicity campaigns and like activities of the company in its relation to public officials, the newspapers and the general public.

STATISTICAL AND ANALYTICAL

There are often included in the executive staff one or more experts trained to prepare analytical and statistical reports upon special problems of operation and management, and to perform other special duties not directly embraced in departmental routine. Some of the titles used in this connection are assistant to president, executive assistant, statistician, librarian, and special agent.

To facilitate these investigations and for the use of department heads and employes, a number of electric railway companies have established their own special libraries wherein are collected, filed and indexed, books, pamphlets, trade journals, statistics and data in reference to electric railway subjects.

MISCELLANEOUS FUNCTIONS

REAL ESTATE

Electric railway companies are large owners of real estate necessary for buildings, yards, terminals, rights-of-way and other purposes connected with the operation of the road. The functions of buying, selling, renting and managing real estate are either assigned to one of the officers or are handled by a real estate agent retained for the purpose.

INSURANCE

An electric railway company carries many forms of insurance, as fire, casualty, boiler, automobile and burglary and also requires court, fiduciary and fidelity bonding. Life, health and accident insurance covering employes under various forms of group and company plans has also recently become a factor in industrial management.

These diversified insurance matters, especially upon the larger roads, are often of sufficient magnitude to warrant the employment of a general insurance expert.

SAFETY-FIRST WORK

The systematic and scientific prevention of accidents, and the education of the public and the employes in safety-first principles, are now thoroughly recognized movements. In electric railway operation the coöperation of all departments in accident prevention work is enlisted under the general direction of an executive officer or one of the department heads. A number of companies retain special experts to supervise this activity.

EMPLOYES' WELFARE

Much is being done by transportation companies in the direction of promoting the well-being and improving the working conditions of employes; for example, by providing old age pensions, sick and death benefits, savings funds, loan systems, profit-sharing systems, recreation rooms, lunch rooms, playgrounds, athletics, social clubs and beneficial associations. On many roads a trained welfare specialist is retained to direct and coördinate the endeavors of the several departments along these lines.

MISCELLANEOUS FUNCTIONS

PARKS AND AMUSEMENT RESORTS

Many railway companies own or are interested in one or more parks or other recreation resorts, necessitating the services of a manager or superintendent especially trained and experienced in park management.

LOST AND FOUND DEPARTMENT

A somewhat incidental function of electric railway operation, but one of considerable importance to the public, is the handling of articles left by passengers upon cars and in waiting rooms. The lost and found property on some large city systems aggregates in the course of a year, 60,000 separate articles, comprising a heterogeneous assortment, ranging widely in variety, *e.g.*, umbrellas by the thousands, human skulls, false teeth, jewelry, money, valuable papers, clothing of every description, lunch boxes, market baskets, books, firearms, dynamite, live puppies, snakes and other animals and even babies.

A story is told of the resourcefulness of a clerk in charge of the lost and found depart-

ment of an important electric railway, who one day found himself the temporary custodian of a lost baby. The clerk, himself a father, was able to feed the baby from a nursing bottle filled with milk heated over an oil stove, the bottle, milk and stove having been requisitioned from his stock of "lost" articles. Then from the same source he secured extra clothing for the child, toys for it to play with and finally put it to sleep in an unclaimed go-cart.

While this may be an exaggerated case, railway companies provide a regular system for handling the property left by careless and forgetful passengers and the utmost diligence is used to insure the return of lost articles to the rightful owners. The lost and found department is usually under the supervision of the transportation department.

PRINTING

An electric railway company uses great quantities of blank forms, tickets, transfers, posters, signs and other printed matter. The

smaller companies have their printing done by established printing concerns; but where the bulk of this work is sufficient to justify the investment, it has been found expedient for the company to equip and operate its own printing plant. Supervision over this function is variously assigned to the secretary, the purchasing agent, or other department best fitted to handle it.

In connection with the company's printing there is usually opportunity for some one to effect considerable economy by standardizing, as to size, paper and typographical arrangement, the blank forms used for recording and transmitting the various departmental and inter-departmental reports. There is also, frequently, opportunity in this regard for intelligent revision and some elimination of blank forms, this being one of the details seldom afforded the analytical supervision it merits.

SIGNALS

Roads which operate at high speed, as do many interurban lines, as well as subway and

elevated systems, are usually equipped with signal devices to safeguard the operation of cars. These signals require constant attention and inspection to insure their proper working at all times; signal engineering and maintenance have therefore come to be a specialized business, in many instances requiring the organization of a separate department in charge of a signal engineer.

DISPATCHING

Most city and interurban lines maintain a central dispatching office, having telephone communication with the various offices, departments, locations, terminals and intermediate points along the lines.

The dispatching system includes a force of trained operatives chosen because of their knowledge and experience in the handling of traffic conditions. The chief dispatcher and his force are charged with the responsibility attending the proper dispatching and operation of cars, including the handling of special routing, special car movements,

prompt action in case of accidents and the quick raising of blockades. This function is under the supervision of the transportation department; but it is closely correlated with the power, wire, car, and track departments, of which each has a part to play in maintaining safety and regularity in the operation of the cars.

Most companies maintain a bureau of information, usually for convenience located at the central telephone dispatching office, where are promptly answered all inquiries concerning time tables, routes and other details about the service regarding which public inquiry is frequently made.

EMERGENCY REPAIR SERVICE

Transportation service seems to be peculiarly liable to interruptions from many causes. The forces of nature, manifested in floods, wind, lightning, snow, sleet and fog, appear to be in continuous conspiracy against the electric railway company in its efforts to provide adequate and regular ser-

vice to the public. Other causes of traffic interruption which call for constant preventive measures and often for quick action are disabled vehicles on the track, drivers blocking cars, trains at railroad crossings, and street accidents of many sorts.

Although practically there is but one source of delay for which the company itself is directly responsible, namely, failure of its own power, track, wires or car equipment, it is necessary to provide in the organization for methods and equipment to raise, with the least possible loss of time, all blockades when they do occur. This "hurry-up" service will be more or less elaborate, depending upon the conditions; but it usually takes the form of a system of district housing stations and a fleet of wreck cars, horse-drawn vehicles and auto trucks, manned by trained crews and equipped with powerful jacks, cranes, extension towers for reaching the overhead wires, block, tackle and other paraphernalia suitable for handling whatever emergency may arise.

This service is operated in about the same manner as a well-regulated fire department, with facilities for prompt notification so that the repair crews can reach, in the minimum time, the location where they are needed. The ordering out of the emergency equipment when required is properly under the control of the transportation department, but the work of preventing and lifting blockades also requires the coöperation of the engineering departments.

PREPARATION OF TARIFFS

As the large majority of electric roads are now subject to regulation by state public service commissions, and many are under the jurisdiction of the Interstate Commerce Commission, it is necessary for these companies to file and publish tariffs showing their official rates for passengers, freight, express and any other class of service supplied to the public. The preparation, printing, filing, posting, publishing and revising of tariffs involves an immense amount of detail work

and familiarity with the accepted principles of rate-making, including local, through, interline, joint, class and commodity tariffs. On the smaller roads responsibility for the proper handling of the details incident to the preparation of tariffs is assigned to the transportation department. On roads having a larger amount of traffic a separate tariff bureau is established to perform this function.

CAR ADVERTISING

Space in electric cars, at stations, and wherever passengers congregate, is in continuous demand for the display of advertisements. It is now accepted practice for the electric railway company to lease all of this available space to some general advertising agency at a stipulated rental, and the agency in turn leases the unit spaces to the individual advertisers.

QUALIFICATIONS IN GENERAL

Obviously, it would be impracticable to attempt a hard and fast definition of the qualifications that lead to successful achievement in the electric railway business.

As in every line of human endeavor, so in the electric railway industry, progressive and permanent success in any of its branches lies in individual effort, natural aptitude and specialized training. Mental poise, loyalty, hard work, cheerfulness, candor, tact, study, experience, and that old-fashioned quality, which in the days of the fathers was called "gumption," count for success in this vocation as in any other; and up to the point where expert or specialized knowledge must be applied, they are the common fundamentals.

Particularly in this field, advancement in any one of its departments is almost wholly a question of a man's power to grasp and assimilate the essentials of its many phases,

his capacity to assume new and larger responsibilities and his ability to make sound decisions upon the diversified problems that are constantly pressing for solution.

EXECUTIVE ABILITY

A quality which counts much for individual success is that combination of characteristics best summarized in the term executive ability; the force that raises a man above his fellows; that qualifies him to issue orders as well as to execute them; that makes him a leader of men rather than one who only follows; that stimulates him to face new problems with confidence and solve them.

The man of clerical mind and clerical habits must train himself to be more than a clerk, and in the long run opportunity is something that each individual creates for himself.

VISION

The electric railway officer has three interests to serve; the public, the employes and the investors. This is now recognized as a

cardinal principle by all progressive and modernized public utility managements. Adequate and dependable service to the public comes first. Employes must be paid the highest possible wages and enjoy the most improved working conditions that the business will produce. Lastly, the investors in the company's securities should be assured a reasonable return upon their investment.

It would seem, and up to the last decade it was well-nigh universally believed, that these three elements must remain in perpetual conflict. But progressive thinkers of recent years are beginning to resolve this seeming conflict into a condition of harmony and mutual coöperation. If still a theory, at least it is a practical and demonstrable theory, that the interest of these three partners is a common interest. Infringement against the rights of one of the partners operates to the detriment of all three. The problem which concerns every public utility is so to interrelate its endeavors that the best interests of all will be conserved.

The electric railway man must therefore be a man of vision and his vision must cover the entire horizon.

FAIR DEALING

That happy faculty of meeting men from any and every walk of life upon a basis of assurance, confidence and understanding is in greater or less degree part of every principal position in the electric railway organization.

A broad fairness of mind should prompt the electric railway man to treat the opinions of others with consideration but he also must be prepared to defend the rights of the company. That is to say, he must be sufficiently broad-minded to see the rights of others and at the same time be able to impress upon others the need for their consideration of the rights of the company which he represents.

The ability to see the manhood in men, to hold the confidence of all manner of men, and to reach amicable adjustments when differences exist weighs much in the balance on the side of success in this business.

QUALIFICATIONS IN GENERAL

TEMPERAMENT

This is no profession for the man of nervous temperament nor for the nature that is easily discouraged under criticism.

If a man be so constituted that public commendation of his work is essential as a spur to larger efforts (and there are such men) he had best not look for progress in the electric railway business; for this is one business where even a man's best intent and purpose are very apt to be misconstrued. Why this should be so is perhaps one of the incongruities of the day. At least in some degree this attitude is based upon misinformation, prejudice and a failure to realize the difficulties and problems confronting those responsible for the management of these public utilities.

Fortunately, signs are not lacking of a change in this respect; and it is to be hoped the time is not far distant when it will be recognized that, by and large, the men who are handling these quasi-public problems have the same high standards of morals, the same ambitions and the same regard for civic

duty and responsibility as do men in other walks of life.

As a matter of fact there is no body of men who are doing more effective civic welfare work in their respective communities than are the electric railway officials as a class. If only for selfish reasons the electric railway officer realizes perhaps more than any one else how closely related is the prosperity of the company to that of the community which it serves. Hence, although the railway official is an employe of a private corporation, he realizes that he and the property which he represents have a greater civic duty than even the ordinary citizen.

The electric railway man will find he is granted but scant personal seclusion. On the street, at his club, at social functions, he must be prepared to listen attentively and without impatience to all sorts of complaints and grievances against the corporation or its employes. This is not to say that some of these complaints are not justified and, if presented at the office in a legitimate way, would

merit investigation and remedy. The point is that the electric railway man is not vouchsafed the same freedom from business matters away from his office that is allowed to other business men.

IDEALISM

In relation to a business so practical and matter-of-fact as that of transportation, there may be a tendency to assume that idealism can find but little place. On the contrary, one of the most valuable assets to the electric railway man is the faculty of creative idealism, using this term in its finest sense to designate that power or process of forming ideal mental concepts: or in non-prosaic language, the faculty whereby "the soul beholdeth the likeness of things that be absent."

This is the mental quality (akin to imagination) which, when tempered with due regard for the practical and relative, enables a man to invent and develop new and better devices, improved processes and better ways of doing things.

ELECTRIC RAILWAY BUSINESS

All progress that has been made in transportation, from the first crude omnibus and horse car, a transition all the more remarkable because it has taken place within comparatively a few years, has been accomplished because upward- and forward-looking men have been able to see beyond the limitations that seemed to hold them, and have brought into physical evidence some of the ideals they first held as mental pictures. And all of promise that the future holds is predicated upon the exercise of constructive idealism.

THE EFFICIENCY HABIT

The rapidly narrowing margin between profit and deficit in the operation of electric railways, due to higher standards of service, increased cost of materials and higher wages paid to employes, makes necessary the elimination of every waste and the conserving of every resource.

This calls for men whose habits of mind run to true efficiency and rational economy and who are able to differentiate between

false economy, expressed by the old adage "saving at the spigot and wasting at the bung," and true economy which saves expenses in legitimate ways, both small and large, without lowering the standards of safety and good service.

PHYSICAL ENDURANCE.

This business calls for a considerable measure of physical endurance and the man who enters it must be prepared to know no limit to the hours he works. The electric railway official, even when not actually on duty, is always subject to call to meet emergencies. Car service is usually maintained for eighteen out of the twenty-four hours, and in the larger communities service must be given for twenty-four hours every day in the year. On Sundays and holidays when in other vocations there is opportunity for relaxation, the strain upon the electric railway organization is heavily increased rather than lessened, for more cars must be operated and there is greater concentration of the traffic.

Keeping the cars running is the electric railway man's gospel, and when the seeming emergencies peculiar to this business arise, the man bred to this business gets on the job as naturally as the cavalry horse responds to the bugle. This applies throughout the organization from the lowliest employe to the manager. Whether it be a big fire that threatens a tie-up, a wash-out on an important line, a break-down at the power house, or a snow-storm, whatever the hour of the day or night, every man whose responsibilities are in any way involved in righting the situation will be found at his post.

One of the impressive features of the electric railway man's life in our northern cities is battling with snow. There is nothing analogous in other industries to this fight with winter's forces that the railway company is periodically compelled to make, and there can be no finer example of loyalty and sacrifice of personal comfort than is exhibited throughout any electric railway organization when such a battle is on.

Perhaps soon after night-fall the warning comes from the local weather bureau to look out for snow, often even before the first flakes are in evidence. Out to the homes of the company's employes, by telephone and by special messenger, goes the rallying call—"snow coming, report for duty." By street car, by automobile or afoot the various divisions of this army begin to mobilize at their respective headquarters and soon the reports are pouring into the central office, "We are on the job—you can count on us."

Then, with but little opportunity for rest or refreshment and against all the odds of cold, wind, ice and snow, officials, superintendents, supervisors, trainmen, linemen, shopmen, trackmen, each with his alloted task, battle hour after hour to keep the tracks open and the cars moving in order that the normal activities of the community may not be paralyzed because of a lack of transit facilities.

From the central headquarters the fight is directed much as a general directs his army

in action. Here are concentrated the telephone reports from the most remote ends of the lines. Sweepers and snow-plows must be kept continuously in action, and while the battle rages the officer in charge issues his instructions, now to the power department, now to the mechanical men, now to the track forces, a word of encouragement here, a caution there, concentrating the efforts at the points where the worst conditions threaten until the storm is over and all the lines are open.

As in modern military tactics the preparations for this battle are made far in advance. In the summer, long before snow is thought of by the public, snow-plows and sweepers are overhauled and put in good repair, crews are assigned to their emergency duties and all the details of snow fighting are arranged.

Forethought and preparedness must also be included in the list of qualifications of the electric railway man.

The man who casts his career in this field

must be prepared to change his place of residence on short notice, for there is a constant demand from the larger properties for experienced men who have made reputations in departmental or managerial work on the smaller roads. Then, too, changes in the ownership of electric roads, necessitating a considerable change in the personnel of the organization, are not infrequent.

SPECIFIC QUALIFICATIONS, TECHNICAL TRAINING AND SPECIALIZED COURSES OF STUDY

Before the prospective electric railway man can intelligently consider the course of study and training best adapted to fit him for this business, it will be necessary for him to determine in a general way what department most appeals to his particular bent of mind. This leads naturally to the query, so frequently asked, what department offers the most likely channel of entrance and the largest opportunity for advancement?

The only specific answer that can be given to this question is that there is no royal road to success in this industry. Should a survey be attempted to show the proportion of successful executives produced by each of the specialized departments the fact would undoubtedly be established that every department has trained its quota of men who have

risen from the ranks to positions of responsibility and leadership. In a broad sense, it can be said that the largest percentage of successful managers have come up through the transportation department, but it is by no means true that this is the only, or even the most sure, avenue of advancement. There are many leaders in the industry who started their careers in some one of the engineering departments. So, too, the accounting, purchasing, claims, and some of the less distinctive departments, have served as the ladder by which men have climbed to the top.

Eventually, the man who arrives at the top must have become a trained specialist in at least one of the main branches; and he must have acquired, by observation, by experience, or by study, or more accurately speaking, by a combination of all three—a workable knowledge of all the departments. It would be folly, therefore, to attempt either to place undue emphasis upon the advantages of any one department, or to advise any specific course of study as affording the best prepa-

ration. Wholesale advice in this connection would be worse than none; for the proposition always leads back to the fundamental premise that the essential element is the individual equation—the man himself, his circumstances in life, his aptitude, his mental and physical characteristics, and so on. All these factors must be known and considered. Moreover, the colleges and technical schools are rapidly revising their courses with the view of more closely meeting the practical requirements of training for this important industry; and any specific advice would be out of date before it could be applied.

As a matter of fact, the question is still under debate as to the advantages possessed by the college man over the man who, instead of spending his preparatory years in acquiring a college education, has devoted this time to gaining practical experience. There are executives whose opinions command respect because of their successful achievements in life, who think a common school or high school education is all-sufficient

as a foundation for life's practical work. These leaders, for the most part, have not themselves had college training, and they speak from this standpoint when they express their preference for men who, as they say, have not been handicapped by the habits, ideas and theories acquired in college life. There are other executives who, when selecting their subordinates, always pick college men.

Probably, reconciliation between these two preferences always will be difficult, for individual conclusion upon the subject will depend upon the individual's point of view. The truth about the matter undoubtedly is the man with the right stuff in him will probably succeed in spite of a college education or in spite of the lack of it.

Bearing upon this question of the relative success of the college graduate versus the non-graduate, considerable interest attaches to a report made a few years ago by a special committee appointed by the American Society of Civil Engineers to investigate the con-

ditions of employment and compensation of civil engineers throughout the country. Based on a canvass of the members of the society, representing a wide range of employment, *i.e.*, national government, states, municipalities, technical schools, railroads, industrial corporations and private practice, the committee reported that the average yearly compensation of 1998 graduates having an experience of from two to fifteen years was $2756. The average yearly compensation of 614 non-graduates, having an experience of the same length, was $3154. The average yearly compensation of 1394 graduates, having an experience of from sixteen to fifty years, was $6328. The average yearly compensation of 719 non-graduates, having an experience of the same length, was $5859. The committee, in commenting upon this result, said: "This may be due to the fact that the preparation of the graduate engineers between the fifteenth and forty-fifth years was more thorough in the fundamentals of engineering education; and that,

whatever may have been their compensation in comparison with that of non-graduates for the first fifteen years of their professional life, this thoroughness of preparation shows its effect from that time onward."

The fact cannot be denied that there are to-day many successful men occupying executive positions with electric railway companies, including the heads of engineering departments, who have not had technical educations. These men, for the most part, have started at the bottom in positions which at the time they "happened" to secure, and they have grown up with the business, so to speak. They have learned the practical side of their work by hard experience, and so much of the theoretical as they have had to know, they have gained by supplementary study and reading.

However, the problems of this business are becoming more and more technical; and while practical rule-of-thumb methods will always be essential, it is probable that the electric railway executive, and particularly

the engineering officer, of the future, will be conscious, after a certain stage of progress has been reached, of a serious handicap if he is not equipped with a theoretical training as the foundation for his practical training.

Notwithstanding that it is not feasible to give specific advice without knowing individual characteristics, it is possible to outline, as has been done in the previous chapters, the functions which go to make up the electric railway organization, and then in a broad way to indicate the qualifications, training and courses of study related to the performance of any particular group of these functions. This will be undertaken under headings as follows:

MANAGERIAL AND TRANSPORTATION

Reference has been made to the diversified character of the problems arising in this business. All of these problems eventually centre in the manager's (*i.e.*, chief executive's) office.

As has been said, these problems are both technical and non-technical. Having dis-

cussed in a previous chapter the responsibilities and duties arising on the non-technical side, it will now be in order to refer to the technical requirements.

The manager must be prepared to discuss with the head of each department the specific subjects pertaining to that department; he must be sufficiently grounded in fundamentals to overrule or concur in the recommendations made by department heads, and not infrequently to suggest some other and better course of action than the one recommended. As he must assume the responsibility for the final decisions, he must be able to weigh all the facts and arguments involved, for his is a judicial capacity. No one of these diversified phases of the business can be slighted, nor undue importance placed upon any to the detriment of the others. In a field so varied, no one official can keep in personal touch with all the minor details, but the manager must thoroughly master the general principles at stake and be qualified to make wise and correct decisions.

Specifically, the manager must be able to discuss intelligently with the auditor questions of finance and accounting; with the claims agent as to the value of any claim for damages and the policy to be pursued as to settlement of the claim; with the purchasing agent as to prices and the relative quality of materials; with the superintendent of transportation upon matters having to do with the transportation service; and with the respective engineering heads upon technical and administrative matters pertaining to power, cars, track, and other phases of engineering.

Particularly must the manager be able to read with understanding, analyze accurately, and gauge correctly, the information conveyed by the daily, weekly, monthly, and annual reports that come from each of the several departments.

With due caution against requiring unnecessary and fruitless reports from his subordinates, he must have, and know, the essentials as to the results accomplished in each department and by each department

in relation to the company's business as a whole. From these departmental reports he gauges the strength and weakness of men and methods, and devises the corrective remedies to be applied where remedy is needed.

So also must the superintendent of the transportation department be an all-around man, for he is the embryonic manager, and on some roads he is the manager. While the manager is concerned with the broader policies and aspects of the company's affairs, the superintendent, perhaps, is a little closer to the ground, so to speak, and comes into closer personal contact with the trainmen and the public. If a fine distinction were to be made between the duties of manager and of superintendent, it could be said that not quite so much is expected of the transportation specialist in the way of general knowledge and experience in handling the other departments of the organization, and more is required with respect to the actual details connected with the service and the transportation employes.

The superintendent of transportation must know what adequate service is, and how to give it. He must above all things be a handler, but not a driver, of men; a square dealer, a disciplinarian and a diplomat.

For the most part, the successful transportation heads, like the managers, have worked their way up from the ranks; and perhaps this is the best if not the only way to learn the transportation branch of the business.

The young man who decides to specialize in the transportation side of the business may start either on the cars as a motorman or conductor or in the office as a clerk. Both of these channels have some advantages and some disadvantages and both have been training ground for successful executives.

In what may be termed the outside or street work, the grades immediately above that of motorman or conductor include inspectors, supervisors, dispatchers, assistant division superintendents, etc., and most electric railway companies make a special point of filling these minor or subordinate positions by pro-

motion from one grade to another as individual merit in connection with opportunities for such advancement makes possible.

There is at least one thing to be said about the man who works his way through the transportation department from the position of conductor or motorman. His promotion may appear to be slow, but when he has "worked through the list," as the saying is, he knows this end of the game first hand and this knowledge will be of value to him as he assumes the larger responsibilities of higher positions.

The office side of the transportation department also has its various grades of positions, including clerks, chief clerks and assistants. The man who enters the business through this channel learns by contact with the clerical details what transportation records are necessary and how they are kept, and he also gradually finds out the factors in transportation expense and the elements of scientific time-table making.

Still another channel of entrance open to

the prospective transportation man is through one of the engineering departments in more or less the same manner as is described under the subsequent sub-heading "Engineering." That is to say, the man who decides to train himself to qualify as a transportation expert will be that much better equipped if he has had two or three or more years, as the case may be, of practical experience in the shops or power house. As a basic rule it may be said that the more the transportation specialist knows about the conditions under which the engineering departments are working, the better transportation man he will be.

Again the discussion leads back to the fundamental conclusion: The important thing is not the particular channel through which the neophyte enters the business; the really important thing is what he makes of himself in the particular position in which he finds himself.

There are as yet no specialized courses of study dealing exclusively with the making

of electric railway administrative and transportation experts, although some of the universities and schools are beginning to see the need in this regard and are offering courses dealing with railway management as a profession. It is to be hoped that those responsible for the progress of American educational resources will recognize the importance of this vocation and will make available to future generations adequate courses of study in transportation theory and principles as preparatory to practical work in this field.

ENGINEERING

All that has been said in the previous chapter relative to general qualifications applies to the engineer as well as to the personnel in other departments, but there are in addition certain characteristics or qualifications peculiar to the engineering branch.

Aptly it has been said that many know the business of engineering but few know engineering as a business. The engineering profession is no longer limited merely

to designing, building, and operating; for the element of administrative capacity, or the ability to take responsibility and make decisions, is as important as the solving of the technical engineering problems. The engineer, by his training and experience, has the best sort of preparation for assuming the duties and responsibilities of the higher executive positions.

From the standpoint of individual accomplishment and caliber, engineers may be grouped into three natural classes:

1. Those who generalize and gradually progress from engineering alone to administrative positions;

2. Those who specialize in one or two lines of engineering and reach their ultimate as heads of their respective specialized departments;

3. Those who constitute the very necessary and wholly honorable grade of skilled workers and mechanics and who represent the timber from which the chief assistants, foremen and sub-foremen are developed.

WHAT THE STREET CAR HAS DONE IN BUILDING UP THE CITIES, THE INTER-URBAN "ELECTRICS" HAVE ACCOMPLISHED IN ENHANCING THE GROWTH AND PROSPERITY OF THE TOWNS AND RURAL COMMUNITIES.

SPECIFIC QUALIFICATIONS

The grade which the individual eventually achieves is the component result of as many variable factors as characterize the human mind; but in the army of industry, as in the army at war, there must be the rank and file and the various grades of officers. Not all can be generals, and none may scorn the private who is doing his allotted task as well as he can.

If there is one characteristic that stands above others as requisite to success in the engineering profession, it is the analytical instinct or mathematical mind; defined as that quality which fits a man to take a proposition, separate it into its fundamental or component parts, and pick out the essentials. Closely allied with this is the faculty of estimating the cost of doing work, for seldom is an engineering operation attempted, whether it be a complicated construction project or a simple repair job, without a preliminary estimate of the cost. The engineer must have an accurate knowledge of the cost of labor, of materials, and of processes, as well as the

capacity to plan and supervise the operations by which the results required are accomplished. This knowledge and this ability are the individual characteristics which differentiate between the mediocre and the really successful achievement.

The engineer must be a handler of men, for if he is to administer his department with the high degree of safety and efficiency expected of it, he must have the coöperation of the men under him, from his chief lieutenants to the lowliest employes in the labor gangs. Brilliancy of ideas will not alone suffice, if there is not this power to engender the team spirit.

The electric railway engineer must be something of a politician and a diplomat; for in the course of his work, because of the occupancy of the public streets and highways by the cars, wires, poles, tracks and other structures of his company, he comes into contact with many borough, town, city, county and state authorities, officials, bureaus, boards and commissions. He must also have

the acumen to understand the viewpoint of the engineer in public office; and by the force of circumstances, in addition to his knowledge of his own work, he will feel the need of familiarizing himself with the progress in municipal engineering, city planning, the good-roads movement and similar public activities.

To the engineer possessed of a wide-angle mind, an attractive field for thought will be the providing of means for training and developing the men under him. In the case of the laborers who work with their hands, this training will include the proper use of tools and of materials; and ascending in the scale of workers he will be constantly endeavoring to find men of particular aptitude to whom he can impart a wider knowledge of methods and processes and to whom he can delegate much of his own responsibility as to details.

As to courses of study, broadly speaking, the man who leans toward electric railway engineering as his vocation will make no mis-

take if he specializes in one of its three main branches, *i.e.*, electrical, mechanical or civil. To the student who develops the necessary individual qualifications, any one of these three specialties offers a direct channel of entrance and advancement. Again, in general terms, of the three, a course in electrical engineering probably offers the broadest and most useful preparation; but whichever course the student selects as his specialty, the more he knows about the other two the better prepared he will be. If he can spare the time to take a combined electrical and mechanical course, he will have had an admirable foundation for beginning his practical training.

In this connection too much emphasis cannot be placed on the desirability of getting all of mathematics that it is possible for him to get, especially in its higher branches. To the engineer, the study of mathematics is valuable, not only for the concrete knowledge thus accrued, but because the study itself develops those mental qualities most needed in this profession.

SPECIFIC QUALIFICATIONS

Fortunately for the man who has been denied the opportunity of a college training, or who desires to enlarge his knowledge of the fundamental theories, there are now available many admirable courses in mechanical, electrical and civil engineering at established manual training schools, night schools, and correspondence institutions, whereby the theoretical can be obtained in conjunction with, or as auxiliary to, the practical work.

Even after completing an engineering course at a university or technical school, there are three or four years in a young man's life that may properly be termed the sandpapering years; the period when the rough edges must be polished off. It is these years that tell whether the man's college training is to be as a stepping stone to his feet or as a mill stone about his neck. If he thinks he deserves at once an executive position of large responsibility and large remuneration solely on the strength of what he has learned at college, his professional degree will be but a handicap. If he appreciates that his theo-

retical knowledge is useful only as it is converted into practical experience, he will be able to make of his theory an aid to greater achievements.

The big problem confronting the embryonic engineer, whether he is a college graduate or not, is to get started upon his life's course of practical training. This can be done only by starting at or near the bottom, and there are several ways of getting started. One of these is by taking advantage of some one of the excellent engineering apprenticeship courses maintained by the larger manufacturing companies. Through these courses the student engineer is given opportunity to become familiar with the various manufacturing operations and by actual work and office experience, he acquires the rudiments of his practical training.

Another way is to obtain a "job" in one of the engineering departments of an electric railway company. This may be either a clerical position or a job in overalls. The latter is to be preferred at the start, for the man

THE "ELECTRIFIED" STEAM ROAD IS THE LATEST DEVELOPMENT IN THE APPLICATION OF ELECTRICITY TO TRANSPORTATION PROBLEMS.

who has had manual labor experience in the power house, in the shops, or in track work, has a long start on the man who tries to learn this phase of the business only by observation. While not all electric railway corporations maintain specific apprenticeship courses, most companies are willing to give a man of the right calibre opportunity to obtain practical experience in the various phases of this work, including, in due course, a knowledge of the executive side of departmental management.

ADMINISTRATIVE

The several administrative departments are, for the most part, specialized businesses assembled under the electric railway organization to perform their individualized functions for the common good of the whole concern.

The qualifications, training, and courses of study pertaining to these offices may be summarized as follows:

SECRETARY

The principal qualifications for the position of secretary are a working knowledge of corporate procedure, aptitude for detail and painstaking thoroughness. The secretary comes in close contact with legal counsel in the routine corporate affairs; it is therefore desirable for him to be familiar with corporation and contract law, particularly as regards the statutes of his own state. A grasp of modern business and efficiency methods and a knowledge of the history of his company and its records are essentials.

A course in an up-to-date business college, with at least a high school education as a foundation, probably offers the best preparation for a man who is "secretarily" inclined.

TREASURER

Integrity of character is the prime requisite for the office of treasurer, and he should have a thorough knowledge of the laws, practices and regulations relating to banking

and finance, together with a working knowledge of accounts.

A business college course in banking and business methods offers excellent preparation for this office.

AUDITOR

A knowledge of the science of bookkeeping and accountancy is of course the first requisite for the electric railway auditor. He must know the principles of finance and banking. He must also be a statistician, particularly as regards "cost keeping," or the recording and analyzing of the cost of doing all sorts of work. In addition, he must have a working understanding of the technical side of electric railway operation. The auditor is not an engineer in the sense that he must qualify to supervise engineering work, but he will need to be generally familiar with at least the terms, materials, and the processes of all the departments. Otherwise, he would fail to grasp to the fullest extent the opportunities as well as the responsibilities of his work.

In recent years the scope of the electric railway auditor has been broadened because of many new and highly technical questions that have arisen in connection with the Interstate Commerce Commission and the public service commissions of the several states. The regulatory laws and commission decisions have brought about the discussion of new accounting principles, especially as relate to depreciation, valuation, renewals, capital charges, and questions of like import. With these new principles in accounting, the railway auditor must be thoroughly familiar.

Summarizing the qualifications of the railway auditor, it has well been said that the more he knows of accounting, finance, law, general business, operation, construction, manufacturing, analysis, and human nature —and the more tact, individuality, originality, and common sense he has—the better railway accountant he will be, and the greater importance will be placed both upon him and his department.

Having assimilated the fundamental prin-

ciples of accountancy as taught in special courses now available at many recognized colleges and business schools, the rest of the electric railway auditor's training comes only by actual experience in routine work. His knowledge of the work of the operating and engineering departments comes by personal contact with the heads of those departments, by observation, and by diligent reading and study of the available printed information bearing upon these subjects.

CLAIMS AGENT

The qualifications essential to success in the claims department can hardly be set down in cold type, for the work has to do almost entirely with the human element in its varied forms of individual expression. Some of the indispensable qualifications are a rigid sense of justice, a keen knowledge of human nature, tact, backbone, courtesy, and some insight into the fundamental principles of psychology. A working knowledge of the governing statutes and court decisions relating

to negligence and liability is necessary, although a complete course in law is not requisite. It has been said that a good lawyer rarely makes a good claims agent.

From the outline previously given of the duties performed by the claims department, it is evident that the school of experience is the best training for the man who would become a successful claims agent. Certainly he cannot learn this work from a correspondence school. As a matter of fact, there has not as yet been established in any of the schools or colleges a course which can be of any help, except perhaps in a very general way, in preparation for this specific work. Actual experience, first in the investigation of accidents, then in adjusting accident claims, and finally in organizing and directing a claims department, is probably the only course to proficiency open to the prospective claims agent.

Claims settlement work, as performed by the life and casualty insurance companies, is somewhat analogous to electric railway

claims adjusting; and a number of successful claims agents have received their early training in the insurance field. Conversely, men experienced in electric railway claims investigating and adjusting sometimes find advancement by changing to insurance adjusting.

PURCHASING AGENT

To coin a term, "purchasingship" is the other side of salesmanship. A purchasing agent must have all the qualifications and attributes of a successful salesman, with the ability to apply these qualifications from the standpoint of buying in distinction to that of selling.

The requirements that stand out prominently as applied to electric railway purchasing are the ability to buy effectively and efficiently, an intimate knowledge of markets and prices of raw and manufactured products, and sufficient judgment as to values and the uses of materials not to disregard the economical balance between price

and quality or value. The head of the purchasing department must be a keen judge of men, of prices, and of material things, generally considered to be the three most potent elements in modern commercial transactions. He must be consistently aggressive; a good bargainer, but not a Shylock, for to exact the last ounce is not always a good bargain; tactful; a square dealer; and with integrity of character above question.

The successful purchasing agent, as opportunity offers, visits the various power plants, shops, car houses and store rooms of the company, talks with the heads and subordinate heads of the departments and so keeps closely in touch with the viewpoint of the men who actually use the materials.

One of the most valuable assets the purchasing agent can have is the good will of the salesmen with whom he comes in contact. The sellers of to-day are trained experts in their respective lines of manufacture and invention, and for the most part they are dignified, gentlemanly, and willing and able to

conduct negotiations in a straightforward, businesslike manner. The purchasing agent who fails to cultivate the acquaintance of these men, obtaining from them all the information he can, and giving them in return the fullest consideration and courteous treatment, although he cannot always give them an order, is doing himself and his company an injustice.

While many colleges and business schools now include in their curriculum, courses in salesmanship, comparatively little attention has been paid to the establishing of courses leading to the training of the man who purchases. Here, therefore, as in other departments of electric railway work experience is the best teacher. The principles of salesmanship as taught in the schools can, however, be studied with profit by the ambitious purchasing agent, and there are several admirable correspondence courses in this subject.

ELECTRIC RAILWAY BUSINESS

IN GENERAL

The man who enters the electric railway field, in whatever capacity, will find that to keep himself abreast of the progress of the business he must continually study his own and other companies' methods. Improvements are constantly being made in methods, devices, apparatus, and processes; and the electric railway man must keep pace with these developments, at once avoiding needless and expensive experimentation, but holding himself alert to apply such of these new ideas as will make for greater safety, reliability or economy in his own particular field.

To the man with ambition, there are available many text and hand books, some dealing with general principles and others with highly specialized details. Help and profit will also be found in close study of manufacturers' and dealers' catalogs, which in these days frequently approach the scope of encyclopædias of knowledge in specialized lines; and particularly the progressive worker in